U.S. Environmental Protection Agency
Toxic Substances Control Act (TSCA)

SECTION 403 RULEMAKING

"...identify lead-based paint hazards, lead-contaminated dust, and lead-contaminated soil."

SECTION 403 DIALOGUE PROCESS

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FORMAT AND STRUCTURE OF THE SECTION 403 RULE

Battelle
. . . Putting Technology To Work

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SUPPORT MATERIALS FOR THE SECTION 403 DIALOGUE PROCESS

INTRODUCTION AND ROADMAP

As part of the TSCA Section 403 rulemaking, EPA will be conducting a dialogue process. The purpose of this process is to gather input from knowledgeable individuals on the best approaches for developing this regulation. In order to help participants prepare for the discussions at the dialogue process, EPA is providing a variety of support materials. In general, these materials include background information helpful for understanding issues associated with developing the rule, as well as lists of specific issues that will be discussed during the dialogue process. In particular, the following papers will provide background information:

- "Scope, Boundaries, and Assumptions of the Section 403 Rulemaking." This paper introduces the Section 403 rulemaking, and outlines the scope, boundaries, and assumptions of the rulemaking.

- "Lead in Residential Paint, Dust, and Soil: Background Information." This paper provides a summary of exposure, prevalence, and sampling information related to lead in paint, dust, and soil. The paper also includes a summary of the effectiveness of different abatement measures as reported in the scientific literature.

- "Format and Structure of the Section 403 Rule: Background Information." This paper provides discussion of issues related to the actual form of the rule, e.g. whether there are separate standards for each media or integrated standards across media.

- "Impact of the Rule and Response to the Rule: Background Information". This paper discusses how different segments of the community may be affected by, or respond to, the Section 403 rulemaking.

EPA is also providing two additional papers which present more technical background information as reported in the scientific literature:

- "A Summary of the Relationship Between Blood Lead and Deteriorated Paint, as Reported in the Scientific Literature." This paper discusses the relationship between blood-lead levels in children and deteriorated paint as reported in the scientific literature.

- "A Summary of the Relationship Between Blood Lead and Lead-Contaminated Soil and Lead-Contaminated Dust, as Reported in the Scientific Literature." This paper summarizes results in the scientific literature characterizing the relationship between blood-lead levels in children and lead-contaminated soil and lead-contaminated dust.

In addition, discussion guides will present the key risk management and policy questions that will be discussed at the meetings. These are:

- "Residential Paint Containing Lead: Discussion Issues"
- "Residential Dust Containing Lead: Discussion Issues"
- "Residential Soil Containing Lead: Discussion Issues"
- "Format and Structure of the Section 403 Rule: Discussion Issues"
- "Impact of the Rule and Response to the Rule: Discussion Issues".

Enclosed in this first package are:

- "Scope, Boundaries, and Assumptions of the Section 403 Rulemaking"
- "Lead in Residential Paint, Dust, and Soil: Background Information"
- "Format and Structure of the Section 403 Rule: Background Information"
- "Residential Paint Containing Lead: Discussion Issues"
- "Format and Structure of the Section 403 Rule: Discussion Issues"
- "A Summary of the Relationship Between Blood Lead and Deteriorated Paint."

The remaining papers and discussion guides will be distributed to participants in October and November.

SCOPE, BOUNDARIES, AND ASSUMPTIONS OF THE SECTION 403 RULEMAKING

1.0 INTRODUCTION

On October 29, 1992, the United States Congress enacted the Residential Lead-Based Paint Hazard Reduction Act (Title X of HR 5334). This includes an amendment to the Toxic Substances Control Act (Title IV: Lead Exposure Reduction) that requires the EPA Administrator to identify lead-based paint hazards. Specifically, Section 403 of TSCA Title IV states:

> "The Administrator shall promulgate regulations which shall identify, for purposes of this title and the Residential Lead-Based Paint Hazard Reduction Act of 1992, lead-based paint hazards, lead-contaminated dust, and lead-contaminated soil."

In and of itself, the Section 403 rule does not require any specific actions, neither hazard evaluation nor hazard control. However, the importance of the Section 403 rule quickly becomes clear when examining the implication of the rule on other provisions of the Title X legislation. The identification of lead-based paint hazards is the basis for a wide range of actions recommended or required by Title X, ranging from eligibility for receiving HUD grants to required abatement of certain segments of Federally-owned housing. In addition, it is reasonable to assume that, following promulgation, many public and private institutions (banks, insurance companies, local health departments) may establish requirements for hazard evaluations and may use the Section 403 standards to define hazards that trigger interim controls or abatements.

2.0 PURPOSE OF THE RULE

The purpose of the Section 403 rulemaking is to identify what constitutes a lead-based paint hazard, i.e., a condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, or lead-contaminated paint that would result in adverse human health effects. In particular, the objective for this Section 403 exercise is to set standards (condition and location of paint, and levels of lead in dust and soil) against which to compare a residential environment when evaluating the presence, scope, and magnitude of lead-based paint hazards. Because environmental lead exposure is most hazardous to young children and pregnant women (because of secondary exposure to the fetus) the standards will be largely designed to protect these two populations.

Several factors influence the approach to be taken in setting Section 403 standards:

1. Difficulty in specifying an acceptable level of exposure to lead. Lead is a toxin that has no known use in the human body and the "level of concern" for lead exposure as measured by blood-lead concentration has been reduced several times in the past 25 years.

2. Difficulty in characterizing how lead exposure occurs. There are numerous sources and pathways of lead exposure, particularly for children, and there is considerable uncertainty in characterizing the relationship between these sources/pathways and children's blood-lead levels.

3. Significant costs, both to individuals and society, of addressing lead exposure through abatement or interim control of lead in paint, dust, or soil.

These factors have led EPA to approach this rule from a risk management perspective. A risk management strategy is also consistent with Title X's purposes: "to implement, a broad program to evaluate and reduce lead-based paint hazards in the nation's housing" and "to to prevent childhood lead poisoning by establishing a framework for lead-based paint hazard evaluation..." (Title X, Section 1003: Purposes. Italics added for emphasis.)

EPA will identify standards that are:

1. focused on preventing lead poisoning before it occurs (primary prevention) rather than treating it after it has occurred (secondary prevention);

2. useful for implementing, on a priority basis, effective actions to prevent childhood lead poisoning;

3. achievable; and,

4. reasonable in that the extent of actions taken in response to the rule should be commensurate with the degree of risk.

3.0 SCOPE OF THE RULE

The Section 403 rulemaking involves specifying standards for identifying a lead-based paint hazard that are protective of the most vulnerable populations (young children and pregnant women). The standards will be used as a comparison reference to lead levels in paint, dust, and soil. Therefore, the type and number of measurements, sampling locations, and sampling methodology by which a residential environment will be compared to the standards will also be discussed as part of the rule. For example, the rule may recommend that its standard be compared to lead levels reported for wipe samples of residential dust, XRF measurements of the paint, and composited core samples of the soil. The amount and location of sampling specified will be an effort to accurately characterize the residential lead-based paint hazard environment.

In addition, EPA believes that the rule should include recommended response actions in support of an overall risk management strategy.

The following are boundaries and limitations on the Section 403 rulemaking imposed by Title X:

1. Section 403 standards related to paint, dust, and soil will for this rule be developed for residential properties only;

2. Intact lead-based paint on surfaces other than impact surfaces, friction surfaces, or surfaces accessible for mouthing or chewing is not under the scope of this rulemaking; and

3. Only "bare soil" is considered potentially hazardous, with "bare soil" to be further defined in the rulemaking.

4.0 DEFINITIONS

Following are definitions to provide a common terminology during the dialogue process. All definitions are taken directly from Title X, the Residential Lead-Based Paint Hazard Reduction Act of 1992.

Abatement means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

(A) the removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead-contaminated soil; and

(B) all preparation, cleanup, disposal, and postabatement clearance testing activities associated with such measures.

_ The term "accessible surface" means an interior or exterior surface painted with lead-based paint that is accessible for a young child to mouth or chew.

_ The term "deteriorated paint" means any interior or exterior paint that is peeling, chipping, chalking or cracking or any paint located on an interior or exterior surface or fixture that is damaged or deteriorated.

_ The term "friction surface" means an interior or exterior surface that is subject to abrasion or friction, including certain window, floor, and stair surfaces.

_ The term "impact surface" means an interior or exterior surface that is subject to damage by repeated impacts, for example, certain parts of door frames.

_ The term "interim controls" means a set of measures designed to reduce temporarily human exposure or likely exposure to lead-based paint hazards, including specialized cleaning, repairs, maintenance, painting, temporary containment, ongoing monitoring of lead-based paint hazards or potential hazards, and the establishment and operation of management and resident education programs.

_ Lead-based paint is dried paint film that has a lead content exceeding 1.0 mg/cm or 0.5 percent (5,000 parts per million (ppm)) by weight.

_ The term "lead-based paint hazard" means any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-contaminated paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects as established by EPA.

_ The term "lead-contaminated dust" means surface dust in residential dwellings that contains an area or mass concentration of lead in excess of levels determined by EPA to pose a threat of adverse health effects in pregnant women or young children.

_ The term "lead-contaminated soil" means bare soil on residential real property that contains lead at or in excess of the levels determined to be hazardous to human health by EPA.

_ The term "inspection" means a surface-by-surface investigation to determine the presence of lead-based paint as provided in section 302 (c) of the Lead-Based Paint Poisoning Prevention Act and the provision of a report explaining the results of the investigation.

_ The term "risk assessment" means an on-site investigation to determine and report the existence, nature, severity and location of lead-based paint hazards in residential dwellings, including--

(A) information gathering regarding the age and history of the housing and occupancy by children under age 6;

(B) visual inspection;

(C) limited wipe sampling or other environmental sampling techniques;

(D) other activity as may be appropriate; and

(E) provision of a report explaining the results of the investigation.

_ The term "target housing" means any housing constructed prior to 1978, except housing for the elderly or persons with disabilities (unless any child who is less than 6 years of age resides or is expected to reside in such housing for the elderly or persons with disabilities) or any 0-bedroom dwelling.

LEAD IN RESIDENTIAL PAINT, DUST, AND SOIL

BACKGROUND INFORMATION

1.0 INTRODUCTION

In the last 25 years, there has been a significant effort in the scientific community to better understand the problem of childhood lead poisoning. In 1970, a blood-lead concentration of 40 µg/dL was established as an action level for children by the Surgeon General. Since then, studies have shown that blood-lead concentrations as low as 10 µg/dL are associated with impaired neurological development in children [1]. Blood-lead levels tend to peak by age 24 months; the Centers for Disease Control (CDC) recommended that children at a high risk for lead exposure have an initial blood-lead test at six months of age, while other children should be initially tested at 12 months [1]. CDC recommended that the following actions be taken based on a classification of the blood-lead level [1]:

- Less than 10 µg/dL (Class I): No action is needed; a child is not considered lead-poisoned at these levels.

- 10-14 µg/dL (Class IIA): A large proportion of children in a community with levels in this range should result in community-wide lead poisoning prevention activities. A child with these levels should be screened every 3-4 months until two consecutive screens are < 10 µg/dL or three are < 15 µg/dL.

- 15-19 µg/dL (Class IIB): The family of the child should be given educational and nutritional counseling. The child should be screened every 3-4 months. If levels persist, a detailed environmental investigation should be made to identify potential pathways of lead exposure to the child, environmental intervention should be conducted where possible, and a full lead-based paint inspection should be performed if resources permit.

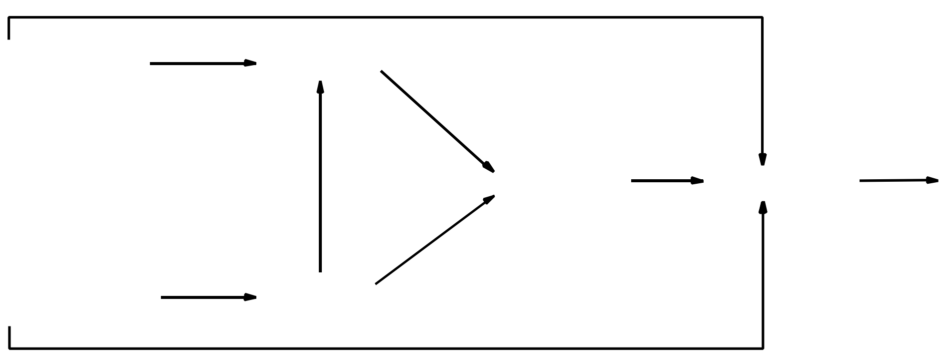
- 20-44 µg/dL (Class III): The child should have a complete medical evaluation which may involve pharmacologic treatment of lead poisoning. An environmental assessment and remediation should be performed.

- 45-69 µg/dL (Class IV): The child should be medically treated, including chelation therapy. An environmental assessment and remediation should be performed. The child's home must be remediated before the child is allowed to return.

- <u>70 µg/dL or higher (Class V)</u>: The child is considered in a medical emergency, with medical treatment and environmental remediation starting immediately. The child's home must be remediated before the child is allowed to return.

Lead has been used in many industrial applications in the United States. Over the years, lead has been used as an additive to paint to make it more durable and to gasoline to make engines run more smoothly, and in countless other products. As the body of knowledge surrounding lead poisoning has grown, the use of lead in paint, gasoline, food containers, solder, and other products has been limited by legislative or regulatory action. With the reductions of lead in air and food, lead in paint, household dust and residential soil have been identified as the significant sources of lead for children, now and in the foreseeable future. Studies and reports have shown that exposure to lead in paint, dust, and soil in residential housing can cause elevated blood-lead levels in children; this information is summarized in the technical papers, "A Summary of the Relationship Between Blood-Lead and Deteriorated Paint, as Reported in the Scientific Literature" and "A Summary of the Relationship Between Blood-Lead and Lead-Contaminated Soil and Lead-Contaminated Dust, as Reported in the Scientific Literature."

When developing approaches to address the problem of childhood lead poisoning, it is helpful to illustrate via a simplified diagram the pathways through which a child is likely to develop elevated blood-lead levels from lead-based paint (LBP) hazards:



This pathway diagram suggests that environmental lead exposure sources influence blood-lead concentrations through the hand-to-mouth activity of the child and direct ingestion of paint. The lead found on the hand of a child results from contact with lead contaminated household dust and/or residential soil. The pathway also indicates that the erosion of interior and exterior LBP contributes to the lead contained in dust and soil, and that lead in soil may contribute to lead in household dust. A variety of other factors such as age, gender, culture, season, and socio-economic status may also influence lead uptake in children.

Many researchers have concluded that LBP is a significant source of residential lead which contributes to elevated blood-lead concentrations in children. In 1978, the Consumer Product Safety Commission banned the sale of LBP to consumers for use in the home. Therefore, houses built before 1978 represent a population of concern for LBP hazards, with older houses (e.g., built prior to 1950) being more likely to contain LBP. In particular, deteriorating LBP poses a potential risk to children, primarily as a source of lead in household dust and residential soil to which children are exposed. In addition, deteriorated LBP can also be directly ingested in the form of paint chips by children exhibiting pica tendencies.

Elevated levels of lead in household dust result from mechanisms including the weathering, deterioration or disturbance of lead-based paint, past atmospheric fallout from the combustion of leaded gasoline, factory emissions, and lead-contaminated dust and soil that migrates into the home from outside. Lead-contaminated household dust is the exposure source most frequently cited in the scientific literature as responsible for elevated blood-lead concentrations in children ([2], [3], [4]). Residences of children with blood-lead levels exceeding 30 µg/dL exhibited significantly higher dust-lead levels than the residences of children with lower blood-lead levels in a number of studies ([4], [5], [6]). The amount of dust lead found on the hands of children with elevated blood lead in these studies was also higher than the hand dust-lead levels for children with lower blood-lead concentrations. At this time, ingestion/inhalation of lead-contaminated dust is thought to be a significant pathway and perhaps the primary pathway for continued elevated blood-lead concentrations in U.S. children [3]. Therefore, lead in interior dust is almost always considered when measures are taken to reduce lead hazards.

Numerous studies suggest that there is a link between elevated concentrations of lead in soil and elevated blood-lead concentrations (>10 µg/dL) in children as documented in the technical background paper, "A Summary of the Relationship Between Lead-Contaminated Soil and Lead-Contaminated Dust". This link has been credited to a direct pathway (inadvertent ingestion due to normal hand-to-mouth activity) and an indirect pathway via soil contribution to lead in interior dust [1]. Whether elevated concentrations of lead in soil result in human exposure and adverse health effects is dependent on a number of factors including the bioavailability of the lead (affected by particle size, speciation, etc.) and the condition and resident use patterns of the soil [1]. Bare soil is of particular concern because it is more accessible to children through both direct and indirect pathways than soil covered with grass, sod, or other vegetation.

In general, there are three primary sources of elevated lead levels in soil: lead-based paint, point source emitters (a fixed site from which lead is released, such as a smelter), and historic leaded-gasoline combustion. In many communities, the elevated soil-lead levels are due to a combination of these sources. In communities where a point source is present, the higher lead levels are often a function of distance from the source. In addition, because lead is an inert metal which does not degrade, lead contamination of soil is additive; that is, additional sources simply increase the extent of the contamination.

Older homes, which are more likely to have been coated with lead-based paint [2], are also often located in the urban center. These residences which may already have elevated lead-based paint levels in their surrounding soil were often also exposed to higher leaded gasoline emissions. Therefore, the inner-city areas of older urban centers are often most at risk for exhibiting elevated soil-lead levels.

The sections that follow provide background information on the three primary sources of environmental lead. Section 2 presents units of measurement and current standards for lead in paint, dust, and soil. Section 3 summarizes the prevalence of lead in residential paint, household dust, and soil throughout the housing stock in the United States. Sections 4, 5, and 6 provide detailed information about how, where, and how much it costs to sample lead in these three environmental media. Section 7 summarizes the efficacy of different types of lead abatement techniques with respect to reducing lead in these three environmental media, and ultimately lowering blood-lead concentrations in children. Section 8 provides a brief summary on the relationship of paint, dust, and soil to children's blood-lead levels.

2.0 UNITS OF MEASUREMENT AND CURRENT STANDARDS

The following three sections describe what measures are used to characterize the degree of lead contamination in paint, household dust and residential soil. Details are also provided on current standards that are being used for interpreting lead levels in these three environmental media.

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Measures of the amount of lead within a defined surface area or the concentration of lead in paint expressed as a percent by weight are used to characterize lead contamination in paint. The amount of lead within a defined surface area is usually referred to as the paint-lead loading and is reported in units of milligrams per square centimeter (mg/cm). The concentration of lead in paint is reported in ppm or as a percent by weight (e.g., 0.5% by weight).

_. Title X defines LBP as having a paint-lead loading exceeding 1.0 milligrams of lead per 1.0 square centimeters, or exceeding 0.5% lead by dry weight of painted surface (5000 ppm).

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Two different measurements that are commonly used for characterizing the lead level in dust are dust-lead loading and dust-lead concentration. Lead concentration, a measure of how much lead is in a given amount of dust, or mass concentration, is expressed in either micrograms of lead per gram of dust (µg/g) or, equivalently, in parts per million lead by weight (ppm). Lead loading, a measure of how much lead is on a surface of given area, or area concentration, is typically expressed in micrograms of lead per area of surface sampled (µg/ft or µg/m).

The determination of whether a particular sample of household dust represents a lead hazard to children may be based on both lead loading and/or lead concentration results. Lead loading alone does not necessarily provide sufficient information for characterizing the extent of a hazard due to the fact that high lead loadings can result from many different types of samples including a small amount of dust with high lead concentration, or a large amount of dust with relatively low lead concentration. High lead loading results combined with high lead concentration results represent lead hazard from contaminated dust and may also indicate an ongoing source of lead that should be addressed. High lead loading combined with low concentration, on the other hand, may indicate the presence of excessive dust in the area sampled that may be able to be addressed by routine housecleaning.

_. Currently, the EPA Section 403 Interim Guidance Document [11] and the HUD Guidelines [10] set limits on lead loadings of no more than 100 µg/ft on floors, 500 µg/ft on window sills, and 800 µg/ft on window troughs allowed inside a home after lead paint abatement has taken place [10]. Details on sampling household dust from floors, window sills, and window troughs are provided in Section 5.2. The HUD guidelines were developed for post-abatement clearance purposes only and are technology-based standards. However, EPA also recommended that until the Section 403 standards are set, these same levels be used for determining the presence or absence of a hazard resulting from lead-contaminated household dust.

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Lead in soil is measured in terms of concentration by weight. Units are micrograms of lead per gram of soil (µg/g), or equivalently, parts per million lead by weight (ppm).

_. Table 1 summarizes the current control actions for elevated soil-lead concentrations as recommended by the EPA Section 403 Interim Guidance Document [11].

3.0 PREVALENCE

The following sections present prevalence data for lead in paint, dust, and soil based on the HUD National Survey [2]. It should be noted that these numbers are estimates of the prevalence of lead nation-wide (in all privately-owned, occupied residential housing built before 1980). There may well exist categories of locations (e.g., large northeast urban areas) where levels of lead are generally much higher than the national average.

Age of home is an important factor related to the presence of LBP within a home. Table 2 provides estimates by age of housing of the percentage of privately-owned, occupied housing units built before 1980 that contain lead-based paint, as estimated by the HUD National Survey. The survey also estimated that 18% of all houses built before 1980 have children aged seven years or younger in residence. This translates to an estimated 12 million homes in the United States that contain both lead-based paint and young children.

Although the large number of estimated homes with lead-based paint represents a reason for concern, the condition of the paint in the home is even more important in determining whether a LBP hazard exists. Title X defines LBP as possibly a hazard only if it is 1) deteriorated, 2) on impact surfaces, 3) on friction surfaces, or 4) on surfaces accessible for mouthing or chewing by a child.

The HUD National Survey defined LBP as non-intact if more than 5 square feet of painted surfaces are peeling, chipping or otherwise deteriorated [2]. Table 3 shows the percentage of privately-owned, occupied homes built before 1980 with LBP and non-intact LBP by location as estimated by the HUD National Survey [2]. Furthermore, it is estimated that 4% of all homes built before 1980 had non-intact lead-based paint and were occupied by a child under seven years of age ([7], Table 2-8).

The HUD National Survey ([2], [7]) estimated the prevalence of residential dust containing lead. Table 4 provides estimates of the number and percentage of privately-owned, occupied housing units built before 1980 that contain lead in interior household dust that exceeds 200 µg/ft for floors, 500 µg/ft for window sills, or 800 µg/ft for window troughs. Table 4 is presented by age of housing.

One of the primary factors related to high levels of dust lead is the presence and condition of lead-based paint within a residence. Residential environments with intact lead-based paint are more than four times less likely to have dust-lead loadings which exceed 200 µg/ft for floors, 500 µg/ft for window sills, or 800 µg/ft for window troughs than houses with non-intact lead-based paint, as seen in Table 5.

Dust lead can also be found at varying levels across different surfaces throughout the residential environment. Table 6 provides estimates of the percentage of privately-owned, occupied homes built before 1980 that have elevated dust-lead levels for different components tested. Elevated dust-lead levels are most common around the windows, likely since they receive dust from both inside and outside the residence. Leaded dust around the windows is found primarily in the window troughs where abraded paint from opening and closing the window can collect, dust can more readily accumulate, and cleaning is more difficult [2].

Table 7 gives the estimated geometric mean and 25th, 50th and 75th percentiles of lead concentration and lead loading within floor dust in dry rooms (i.e., no plumbing), wet rooms (i.e., plumbing present), and entryways of privately-owned, occupied homes built before 1980. Entryway dust-lead loadings are higher than wet or dry room dust-lead loadings, probably due to the migration of lead-contaminated exterior dust and residential soil into the home.

_. Data on lead levels in dust from the Rochester Lead-In-Dust Study [28] and the Urban Soil Lead Abatement Demonstration Project [27], known also as the Three City Lead Study, are provided in this section as an example of observed dust-lead levels in homes in several urban environments. These data should not be interpreted as being representative of national prevalence, or even representative of prevalence in the localities in which samples were collected. Rather they should be viewed only as case studies of potential dust-lead levels in several urban environments. In addition it should be emphasized that the Three City Lead Study targeted metropolitan areas with elevated levels of lead contamination and evidence that there were children with elevated blood-lead levels.

The Rochester Lead-In-Dust Study was conducted to determine the relation of lead loading and lead concentration of house dust to blood-lead levels among urban children. The study included environmental measurement of lead in approximately 200 residences. These residences housed eligible subjects who were selected from lists of sequential births between March 1, 1991 and September 30, 1992 from three urban hospitals in Rochester, New York. Eligible children were in the 1 to 2½ year age range and were subject to a variety of eligibility requirements.

The purpose of the Three City Lead Study was to determine whether abatement of lead in soil could reduce the lead in blood of inner city children. The three cities selected

— Boston, Baltimore, and Cincinnati — were in part selected because of their potential for elevated soil-lead concentrations in residential areas. The sampling plan by which families were enrolled in the study varied across the cities, but all families resided in communities within the city targeted as exhibiting elevated soil lead.

Table 8 provides estimates of the number and percentage of housing units in the Rochester Lead-In-Dust Study that reported a dust-lead loading in the kitchen, play area, bedroom, or entryway that exceeded 200 µg/ft for uncarpeted floors, 500 µg/ft for window sills, or 800 µg/ft for window troughs. Estimates are reported based on vacuum method sampling — as employed in the Baltimore Repair and Maintenance Study (BRM vacuum) [29] — and wipe method sampling, and are presented by age of housing.

Table 9 presents the percentage of residences in the Rochester Lead-In-Dust Study that had a dust-lead loading in the kitchen, play area, bedroom, or entryway greater than 200 µg/ft for uncarpeted floors, 500 µg/ft for window sills, and 800 µg/ft for window troughs, for each surface examined.

Table 10 gives the estimated geometric mean and 25th, 50th, and 75th percentiles of the arithmetic average of BRM vacuum lead concentrations and lead loadings for dust samples collected from uncarpeted floors in the kitchen, play area, bedroom, and entryway of the Rochester residences. Estimates are also reported for wipe-lead loadings from dust samples collected from uncarpeted floors.

Widely varying pre-intervention interior household dust-lead loadings and concentrations were reported for the Three City Lead Study [27]. Table 11 presents approximate arithmetic averages for dust-lead loadings for each city across all abatement treatment categories which reflected communities within the specified city that were targeted for a fixed set of intervention strategies. Approximate dust-lead levels reported are based on pre-intervention measurements. Table 12 presents approximate arithmetic averages for dust-lead concentrations for each city.

Lead is present in soil at a variety of levels in regions throughout the United States. While naturally occurring levels in soil are usually below 50 ppm [8], considerably higher levels are commonly observed at private housing units. Table 13 presents percentiles associated with the soil-lead concentration data from the HUD National Survey. The HUD National Survey suggests that approximately 16 million private housing units (20 percent of the national private housing stock) have soil-lead concentrations above 500 ppm [7]. The HUD National Survey results also indicate that the percentage of the private housing stock with soil-lead concentrations above 500 ppm decreases with construction year (Table 14).

While it is difficult to determine which is the dominant lead source within a community without a point source, in many cases lead-based paint is an important contributor to higher concentrations in soil. Non-intact exterior lead-based paint was associated with the highest percentage of residences with soil-lead concentrations exceeding 500 ppm, the reference value used for summaries and categorization in the HUD National Survey (Table 15). Moreover, the highest geometric mean soil-lead levels are usually reported adjacent to older (and therefore more likely to contain lead-based paint) residences (Table 16).

_. Data on lead levels in soil from the Rochester Lead-In-Dust Study [28] and the Three City Lead Study [27] are provided in this section as an example of observed soil-lead levels in homes in several urban environments. These data should not be interpreted as being representative of national prevalence, or even representative of prevalence in the localities in which samples were collected. Rather they should be viewed only as case studies of potential soil-lead levels in several urban environments. Again, it is worth emphasizing that the Three City Lead Study targeted homes with elevated levels of lead contamination. A brief description of the two studies was provided in Section 3.2.1 above.

Soil samples in the Rochester Lead-In-Dust Study were sieved and divided into separate coarse and fine samples before analysis. Total sample (coarse and fine recomposited) concentration could not be calculated for this paper. However, the coarse and fine sample concentrations were in general agreement as reflected by:

- a .84 correlation between coarse-sieved foundation perimeter samples and fine-sieved foundation perimeter samples

- a geometric mean of 981 µg/g for coarse-sieved foundation soil and 732 µg/g for fine-sieved foundation soil, and

- a geometric mean of 299 µg/g for coarse-sieved play area soil and 271 µg/g for fine-sieved play area soil.

Table 17 provides reported percentiles for lead concentrations in coarse-sieved soil at the child's play area and at the house's foundation perimeter from the Rochester Lead-In-Dust Study.

Table 18 provides the percentage of residences with soil-lead concentrations above 500 ppm for coarse-sieved soil in both the play area and foundation perimeter by different housing age categories.

Table 19 presents the geometric mean soil-lead concentrations for coarse-sieved soil from both play areas and the foundation perimeter by age of housing. The oldest residences were reported as exhibiting the highest geometric mean soil-lead concentrations at the foundation perimeter, but not necessarily at the child's play area.

Widely varying pre-intervention soil-lead concentrations were reported for the Three City Lead Study [27] communities. Table 20 presents approximate arithmetic averages for lead concentrations in soil samples for each city.

4.0 HOW TO SAMPLE

The method of sampling environmental media for lead at a residence is dependent on the requirements of the type of evaluation. Types of evaluation include 1) a hazard screen, 2) a risk assessment, or 3) a LBP inspection. Discussion of hazard screens, risk assessments, and LBP inspections in this section and sections 5 and 6 are based on current EPA draft definitions and descriptions to be included in Section 402/404 rulemaking. The sampling requirements are presented for illustration only and do not indicate decisions on sampling for the Section 403 rule.

The following descriptions are taken from the draft Section 402/404 rule:

- A hazard screen is an abbreviated, and hence lower cost, risk assessment that includes visual inspection, testing of deteriorated paint, composite dust samples, and no soil sampling.

- A risk assessment includes visual inspection, testing of deteriorated paint, composite or separate dust samples, and composite soil sampling.

- A LBP inspection involves testing each painted component with a distinct painting history in every room and each exterior component with a distinct painting history.

For the purpose of Section 403 standards, a full LBP inspection may not be relevant since intact paint that is not on friction, impact, or chewable surfaces is not considered a hazard. Limited sampling of intact paint that focuses testing on friction, impact, or chewable surfaces may be necessary if these surfaces are included in the rule.

Discussion of methods for sampling paint, dust, and soil, taking into consideration the type of evaluation, is presented in the following sections.

EPA and HUD currently recommend two procedures for determining lead levels in paint: sampling by X-ray fluorescence (XRF) or paint chip sampling for laboratory analysis. XRF sampling is the most common approach to conducting paint inspections, with paint chips sampled for components that either cannot be tested by XRF or where XRF sampling yields inconclusive results. In a risk assessment or a hazard screen, only lead levels in deteriorated paint are of interest. Therefore, paint chip sampling is the most common approach to conducting risk assessments or hazard screens.

When XRF sampling is conducted, the EPA Section 403 Interim Guidance Document [11] and the HUD Guidelines [10] recommend that a portable K-shell XRF instrument be used. In single-family housing, the result of XRF sampling on a painted component should be based on the average of three XRF readings at locations distributed across the component surface. In multifamily housing having the same types of components in each unit, only one XRF reading is taken on a given painted component, with the location on the component changing from one housing unit to another. If the XRF instrument has a new radioactive source, each XRF reading is taken for a duration of at least 15 seconds. Longer sampling durations are necessary with older radiation sources used in the instrument.

Studies have shown that the precision of an XRF measurement varies by substrate (i.e., the material underneath the LBP, such as wood, plaster, brick, concrete, drywall, or metal.) [2]. Therefore, XRF readings should be substrate-corrected as outlined in the HUD Guidelines [10], unless stated otherwise by the XRF manufacturer.

For certain XRF instruments, several studies have found the XRF measurements to be imprecise in detecting lead levels in paint at or near the Title X level of 1.0 mg/cm [2]. To take this imprecision into account, these instruments are associated with an inconclusive measurement range. A result is inconclusive on the presence of LBP if the (substrate-corrected) XRF reading falls within a pre-determined range surrounding 1.0 mg/cm. An example of an inconclusive range cited in the EPA Section 403 Interim Guidance Document [11] is from 0.4 mg/cm to 1.6 mg/cm. The inconclusive range is dependent on the accuracy and precision of the XRF instrument and is typically specified on XRF Performance Characteristic Sheets.

When the presence of LBP cannot be determined by XRF testing (either due to inconclusive results or when the surface cannot be tested by the XRF instrument, such as highly curved or ornate surfaces commonly found in older homes), laboratory analysis of paint-chip samples is recommended. The laboratory analysis protocol requires that paint chips be taken from an area representative of the component to be characterized. The EPA Section 403 Interim Guidance Document [11] recommends paint chips have a 1 square-inch area, while the HUD Guidelines [10] recommend a 4 square-inch area. When the paint chips are scraped off the surface, care must be taken that the substrate material is not included in the paint chips. After collection, paint chip samples are sent to a laboratory for analysis using Atomic Absorption Spectrometry (AAS) or Inductively Coupled Plasma/Atomic Emission Spectrometry (ICP/AES). The laboratory must be recognized by the EPA National Lead Laboratory Accreditation Program (NLLAP).

Although laboratory analysis of paint chip samples yields more precise measurements than portable XRF testing and has no inconclusive range, there are significant advantages to using the XRF instrument: 1) results are available immediately, 2) the laboratory analysis is more expensive than an XRF reading, and 3) painted surfaces do not have to be disturbed when a portable XRF measurement is taken.

Chemical test kits for detecting the presence of lead in paint have been advertised as an alternative approach to paint sampling by XRF or laboratory analysis. These kits use a chemical reaction, such as a color change, to determine the presence of lead in paint. The Federal Government does not recommend using chemical test kits for determining the extent of LBP in homes, as they were found to be unreliable [12].

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Residential lead in dust can be measured in a variety of ways. Two fundamentally different technologies for obtaining dust lead samples are vacuum and wipe sampling. Wipe sampling methods, which use a wet wipe applied against the sampling surface, measure lead loading directly but do not give information on lead concentration. Vacuum sampling techniques, which use a vacuum device to collect dust onto a filter or into a collection bottle, measure both lead loading and lead concentration.

It is difficult to directly compare the results from wipe and vacuum dust-sampling. In addition, results from the same method (for example, vacuum sampling) using different apparatus or procedures may differ greatly [13]. In selecting a complete sampling strategy to assess lead hazards or the impact of lead hazard interventions, it is important to understand the entire sampling procedure. Well documented, consensus operating procedures are currently only available for wipe sampling, with standards for a dust vacuum method now being balloted by American Society for Testing and Methods (ASTM) [14]. Many studies investigating either effectiveness of abatement or relationship between dust lead and blood lead depended on non-standardized techniques for dust collection and measurement. Choice of residential dust-lead standards (loading or concentration) depends explicitly on the dust collection method.

Based on current development of the Section 402/404 rule, composite dust samples are recommended in a hazard screen. A composite dust sample consists of multiple dust samples collected from different locations in the residence which are combined prior to chemical analysis. The lead loading and/or lead concentration associated with a composite sample can be interpreted as the area-weighted average lead level spanning the different locations sampled. In a risk assessment, either composite or individual dust samples are recommended for analysis.

There are several advantages and disadvantages to collecting and analyzing composite samples. The primary advantage of compositing is related to cost savings from not having to chemically analyze multiple individual samples. A technical disadvantage is the loss of specific information (inability to identify which locations within the composite sample had the high lead concentrations or loadings). A disadvantage of wipe composite sampling is the difficulty associated with analyzing composite samples that include more than four wipes (i.e., representing more than four sampling locations).

In risk assessments, a primary function of soil inspection, measurement, and testing is to identify potentially hazardous areas and to determine appropriate control actions needed to prevent exposure to a hazard resulting from lead contaminated soil. In general, the first step in this determination is to visually examine the ground surrounding a residential dwelling for bare soil areas. If no bare soil is present , then both the EPA Section 403 Interim Guidance Document [11] and the HUD Guidelines recommend no further action. However, in the majority of housing units there are some areas of bare soil, and soil sampling is then required.

EPA's Section 403 Interim Guidance Document [11] suggests that at least two composite soil core samples be collected. Each composite sample should consist of 3 to 10 subsamples. The subsamples should be collected using a coring tool to gather the top 1/2 inch of soil. In circumstances where the composition of the soil prohibits the use of a coring tool (e.g., sandy soil) the top 1/2 inch of soil should be collected using a stainless steel scoop. Extra effort should not be taken to collect visible paint chips; however, any paint chips collected during the course of soil sampling should be included in the sample for chemical analysis.

5.0 WHERE TO SAMPLE

In hazard screens and risk assessments, the current development of the Section 402/404 rule stipulates that only deteriorated paint is considered in the paint sampling process. All components with deteriorated paint are identified in each room of the residence, as well as on the exterior of the residence, and the paint history of each of these components is noted. For interior components with deteriorated paint, one paint chip sample is collected from each component with a distinct paint history in each room. For exterior components with deteriorated paint, one paint chip sample is collected from each component with a distinct paint history. In common areas within multi-family dwellings, paint chip samples are collected from each component with deteriorated paint and with a distinct paint history.

In LBP inspections, all painted components in the interior and exterior of the residence (and in common areas of multi-family dwellings) that were installed prior to 1979 are identified, regardless of the paint condition. One XRF sample is taken per component with a distinct painting history in every room or common area, and one XRF sample is taken per exterior component with a distinct painting history. XRF samples are not necessary on components determined not to contain LBP. Follow-up paint-chip sampling is performed on components with inconclusive XRF results (one paint chip per component).

Limited sampling of intact paint that focuses on friction, impact, or chewable surfaces might be conducted by XRF, with follow-up paint-chip sampling of inconclusive XRF results.

In accordance with the current development of the Section 402/404 rule, dust sampling would occur both in hazard screens and risk assessments. In the visual inspection of the residence, rooms are identified where children age six and under are most likely to come in direct contact with dust and where dust samples from floors and windows (sills or troughs) can be collected. Window troughs (sometimes called wells) are defined as the portion of the horizontal window sill that receives the window sash when the window is closed, often located between the storm window and the interior window sash.

In a hazard screen of a residence, two composite dust samples are collected from the rooms identified in the visual inspection. One composite sample consists of dust from floors, while the other consists of dust from windows. In multi-family dwellings, additional composite dust samples are collected from each common area where children are likely to come in direct contact with dust. A floor-dust composite sample and a window-dust composite sample would be collected from each of these common areas.

The number of dust samples required in a risk assessment is dependent on the visual inspection of the property. Either composite or individual dust samples are collected from the rooms identified in the visual inspection. In multi-family dwellings, dust samples from floors and windows in common areas adjacent to a sampled unit and other common areas that may pose a LBP hazard to children aged six and under are also collected. These dust samples can be either composite or individual samples.

In risk assessments, according to the current development of the Section 402/404 rule, composite soil samples are to be collected from exterior play areas where bare soil is present and dripline/foundation areas where bare soil is present.

6.0 SAMPLING COSTS

Table 21 contains estimates of sampling and analysis costs for collection and analysis of paint, dust, and soil samples for a hazard screen, a risk assessment without sampling intact paint, and a risk assessment with limited sampling of intact paint. The hazard screen includes composite dust sampling and sampling of paint only if it is deteriorated. The risk assessment without sampling intact paint includes individual dust wipe samples, composite soil samples, and sampling of paint only if it is deteriorated. The risk assessment with limited sampling of intact paint includes XRF testing of friction, impact, or chewable surfaces, in addition to the previously listed risk assessment sampling. The cost estimates in Table 21 were derived by adapting risk assessment and paint inspection cost components estimated for the Section 1015 Task Force to the different sampling options. The cost estimates include a sampling cost (including fixed costs), an analysis cost (based on an estimated number of samples and a per sample analysis cost), and total sampling and analysis costs. The costs presented are for sampling and analysis only and do not include other risk assessment costs such as presenting hazard control options or preparing reports.

Table 22 presents a comparison of sampling and analysis costs for collection of ten (10) individual dust samples by wipe sampling versus vacuum sampling. These cost estimates were based on conversations with an EPA sampling and analysis contractor and a LBP inspection contractor for the State of Maryland.

7.0 ABATEMENT EFFECTIVENESS

All the abatement effectiveness studies reported in the scientific literature to date measured efficacy among already exposed children (i.e., they are secondary prevention studies). There is an important consideration to recognize when measuring effectiveness in already exposed children. Because of their past exposure to lead, the children have accumulated a significant reservoir of lead in their bone tissue. At least a portion of this reservoir is available for mobilization into the blood following an abatement. This resulting bone-lead mobilization has the potential to mask the full effectiveness of an abatement for an extended period of time by keeping post-abatement blood-lead concentration elevated. Although an abatement may have been successful in eliminating lead exposure to the child, the mobilized stores will cause blood-lead concentrations to suggest a more limited effectiveness for the abatement. Therefore, the abatement effectiveness results reported here may have only limited relevance to primary prevention standards for residential lead.

7.1 <u>Paint</u>

From 1981 to 1994 ten studies have examined the effectiveness of the abatement of residential lead-based paint [15]. In all ten cases, the interventions targeted primarily the child's residential environment usually utilizing partial abatements less extensive than those outlined in the HUD Guidelines [10]. Also, the studied interventions principally sought "secondary" rather than "primary" prevention (e.g., assessing the effectiveness of lead hazard intervention on already exposed rather than unexposed children). The post-abatement measures were usually relatively short-term (i.e., no more than one year) and were typically conducted on children with blood-lead levels greater than 20 µg/dL (i.e., they had been identified for the studies because they had significantly high blood-lead levels).

In some of the earlier studies (Baltimore Traditional/Modified Paint Abatement and Boston Retrospective Paint Abatement Study) abatements such as dry-scraping or sanding with HEPA vacuum attachments and blow torching produced short-term increases of blood-lead levels in children. Similarly, improper or insufficient cleaning after abatement resulted in elevated blood-lead concentrations [15]. When proper lead-based paint abatement strategies such as encapsulation, enclosure, or removal and replacement of painted components were employed, a 15-25% decline in the blood-lead levels of the resident children resulted by approximately one year after the interventions. For example, the mean blood-lead level for 132 children declined from 26.0 µg/dL to 21.2 µg/dL in the Central Massachusetts Retrospective Paint Abatement Study and from 34.9 µg/dL to 26.7 µg/dL in the 1990 St. Louis Retrospective Paint Abatement Study [15]. There is evidence of reduced effectiveness among children with blood-lead concentrations less than 20 µg/dL. Post-abatement percent reductions in dust-lead loadings reported in the literature were considerably greater than percent reductions in blood lead, some on the order of greater than 90%.

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There are three studies which involved educational interventions and 2 non-educational studies reported in the scientific literature that are useful for characterizing the efficacy of dust abatement. The two non-educational dust abatement studies primarily employed in-place management methods [15]. In contrast to paint abatement methods it seems unlikely that dust abatement methods aggravate childhood lead exposure if performed improperly. The Baltimore Dust Control Study [16] focused on managing the dust-lead hazard after removing or isolating the lead-based paint hazard identified within the residence. Regular, extensive dust-lead hazard management efforts by trained personnel in this study produced an 18% decline in mean blood-lead concentration (from 38 µg/dL to 31 µg/dL) for affected residents; a control population exhibited only a 2% decline in mean blood-lead concentration [16]. The Baltimore study noted that, "in most homes the initially high [dust-lead] levels were again present within 2 weeks after the first visit" [16], although eventually dust-lead levels remained low between visits. Similarly, the one-time dust abatement and paint stabilization performed in the Boston 3-City Soil Abatement study [17] reduced window well dust-lead loadings for only a short period of time.

The three educational dust intervention studies also employed in-place management methods. In-home educational visits emphasized proper housecleaning methods to reduce dust-lead levels, emphasized improved hygiene habits to reduce hand-to-mouth lead exposure, and educated families on proper nutrition to reduce the health effects of elevated body-lead levels. No abatements were performed in the study homes. The Granite City Educational Intervention Study ([19], [21]) found a 32% drop in mean blood-lead level from extensive educational outreach (a drop from 14.6 µg/dL to 9.6 µg/dL, on average). The implication of this decline was difficult to ascertain, however, since no measurements were collected for a control group of children. Both the Milwaukee Retrospective Educational Intervention Study [21] and Milwaukee Prospective Educational Intervention Study [22] reported 18% declines in blood-lead concentrations (from 22 µg/dL to 18 µg/dL) following in-home educational visits. The declines following educational intervention for these studies were significantly greater than declines observed in control children. As these studies examined short-term efficacy (less than 12 months), however, it is unclear what level of effectiveness might result long-term.

There is mixed evidence on the impact of soil abatement alone on the blood-lead concentrations in moderately exposed children. The EPA is in the process of completing reports summarizing studies in Boston, Baltimore, and Cincinnati (the Three City Soil Abatement Demonstration Study) to investigate the impact of reducing soil-lead concentrations on children's blood-lead levels ([17], [23]). Published results from the Boston Study suggest that "a soil-lead reduction of 2060 ppm is associated with a 2.25 to 2.70 µg/dL (micrograms per deciliter) decline in blood-lead levels..." It should be stressed also that two control populations not benefitting from soil abatement exhibited less extensive, but significant, declines. The results of the study also indicate that within 1-2 years following the abatement, the soil was not recontaminated. However, care needs to be taken when interpreting these results. Additional intervention strategies (paint stabilization and a one-time dust clean-up) were also performed at the time of the soil intervention. The efficacy of the soil intervention may be confounded with the efficacy of the lead-based paint stabilization and the possibility of seasonal variation in blood-lead levels. More importantly, preliminary results from the Baltimore and Cincinnati portions of the study, where the preabatement soil-lead levels were lower and may not have been a significant source of lead relative to other sources, did not indicate a significant reduction in children's blood-lead levels as a result of the soil abatement [27].

8.0 RELATION TO BLOOD-LEAD CONCENTRATION

Lead-based paint is considered a primary source of elevated blood-lead concentrations in children [24]. When considering lead-based paint in a deteriorated state, studies such as [25], [26] provide evidence that the presence of deteriorated lead-based paint is related to the frequency of elevated blood-lead concentrations. However, no information quantifying the relationship between deteriorated paint and blood-lead levels, such as a slope factor relating square feet of deteriorated paint to blood-lead levels, was uncovered in the literature search for this paper. Further details on the relation between paint and blood-lead concentrations is provided in the paper, "A Summary of the

Relationship Between Blood-Lead and Deteriorated Paint, as Reported in the Scientific Literature."

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During the past 20 years, a great many studies have been conducted to determine the sources responsible for lead exposure in children. These studies initially emphasized exposure from lead in paint and leaded gasoline emissions, but increasingly have focused principally on two environmental media, residential dust and soil, often contaminated by these original sources. The results from these studies are qualitatively similar in that the association between environmental lead and blood lead is consistently positive and, when considered without the confounding from additional variables, statistically significant.

A number of researchers have attempted to combine these disparate results into a single set of coefficients that provide one representative quantitative measure of the relationship between blood-lead concentration and soil- or dust-lead concentration. These attempts are summarized in the technical background paper, "A Summary of the Relationships Between Blood Lead and Lead-contaminated Soil and Lead-contaminated Dust, as Report in the Scientific Literature." If the differences in the underlying fitted regression models are ignored and the coefficient estimates pooled, among urban communities the reported soil slope coefficients (at the geometric mean soil-lead concentration) range between 0.24 and 14.39 µg/dL change in blood lead per 1000 ppm change in soil lead, while among smelter communities the range is between 0.03 and 11.91. The dust slope coefficients range from 0.01 to 10.44 µg/dL change in blood lead per 1000 ppm change in dust lead among urban communities (at the geometric mean dust-lead concentration) and from 0.81 to 62.00 among smelter communities.

LEAD IN RESIDENTIAL PAINT, DUST, AND SOIL

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Residential Paint Containing Lead

DISCUSSION ISSUES

The Environmental Protection Agency (EPA) is seeking comment and insight into a range of relevant issues related to lead in paint. What follows are a series of discussion issues with associated questions. Where appropriate, supporting text is provided to guide the discussion.

Title X defines deteriorated lead-based paint as, "any interior or exterior lead-based paint that is peeling, chipping, chalking, or cracking or any paint located on an interior or exterior surface or fixture that is damaged or deteriorated." Under this definition of deteriorated, however, most residences would be said to have some deteriorated paint. Expansion and shrinkage of walls from pressure and temperature differences can cause paint to crack. Establishing a level of deterioration would enable decision-makers to differentiate properties with hazards from well maintained properties that are unlikely to present risks to the occupants. As a starting point EPA will consider the levels established for risk assessors in the HUD Guidelines [1] presented in Table 23 below.

Should levels on the amount of deteriorated paint be defined (e.g., the minimum area of interior or exterior deteriorated lead-based paint that could be expected in a well-maintained residence)?

How would such levels be defined?

Title X defines lead-based paint as a potential hazard if it is 1) deteriorated, 2) on impact surfaces, 3) on friction surfaces, or 4) on surfaces accessible for mouthing or chewing by a child. The degree to which these surfaces pose a real hazard is unclear. Currently, the EPA does not have any data indicating a link between intact lead-based paint on friction and impact surfaces and lead-contaminated dust, although one could logically assume a connection. Similarly, although anecdotal evidence suggests few children chew on architectural components such as window sills, the potential for mouthing exists. If, in fact, these surfaces do not present a hazard then including them may result in a misallocation of resources, with abatement of these components yielding little risk reduction. On the other hand, the definition of lead-based paint hazard should promote primary prevention of exposure.

How should EPA try to balance cost effectiveness and allocation of resources to priority hazards with the Title X goal of primary prevention?

Is it appropriate for EPA to set a standard for these surfaces which considers whether there is a lead dust hazard in determining whether a friction or impact surface is a hazard?

Research has shown that there is a high degree of variability when measuring lead in samples of paint, dust, and soil. There are many potential sources of this variability including sampling method, laboratory analysis, and spatial and temporal variation. (For example, field duplicate paint-lead measurements of the same component often vary by as much as 40%.) Increasing the number of samples compensates for this variation by providing a more accurate assessment of both average levels and ranges of contamination. However, increasing the level of sampling also raises the costs. To determine the appropriate level of sampling EPA will attempt to find the optimal balance between cost and certainty.

Table 21 in Section 6 of "Lead in Residential Paint, Dust, and Soil: Background Information" includes estimates of sampling and analysis costs for different sampling options. Based on this information, how should EPA balance sampling and analysis costs with the added certainty that additional samples provide?

Each model of an XRF instrument has an associated inconclusive measurement range at or near the Title X level of 1.0 mg/cm. When an XRF measurement falls in the inconclusive range, laboratory verification by paint-chip analysis is required. Is the information gained from laboratory verification of inconclusive XRF readings significant enough to merit the additional cost (from the standpoint of damage to the home, cost of the analysis, and delays in getting the results)?

Section 3 of "Lead in Residential Paint, Dust, and Soil: Background Information" presented prevalence data from the HUD National Survey. It should be noted that these numbers are estimates of the prevalence of lead nation-wide (in all privately-owned, occupied residential housing built before 1980). There may well exist categories of locations (e.g., large northeast urban areas) where levels of lead are generally much higher than the national average. EPA intends to use the HUD National Survey data in assessing the effect of the Section 403 standards, but is interested in other representative data if it exists. Are you aware of any such data and could it be provided to EPA?

Are you aware of any data concerning the prevalence of LBP on friction, impact, or chewable surfaces?

RESIDENTIAL PAINT CONTAINING LEAD

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FORMAT AND STRUCTURE OF THE SECTION 403 RULE

BACKGROUND INFORMATION

1.0 INTRODUCTION

Other issues papers for the dialogue process address the prevalence, measurement, and assessment of lead-based paint, lead-contaminated dust, and lead-contaminated soil. All three lead exposure media must be included in the Section 403 Rule. There are decisions to be considered, however, in determining the form of the rule, including whether to include use patterns, to set multiple tiers of standards, or to combine media in an integrated standard. This issue paper provides background for those issues relevant to the format and structure of the Section 403 Rule.

2.0 USE PATTERNS

When considering standards, it might be important to also account for use patterns of the two populations (young children and pregnant women) most at risk, as well as other residents (or potential residents). The assessment of human health risk incorporates not only the presence of available sources of lead in paint, dust, or soil, but also the likelihood of human contact. Consideration of use patterns is in accord with a risk management strategy of focusing available resources on areas of greatest threat, and also in accord with Title X's stated purpose of developing a program to evaluate and reduce lead-based paint hazards in the nation's housing on a priority basis.

An example of accounting for use patterns may be found in the EPA interim Section 403 guidance [1] and the HUD Guidelines [2]. The interim Section 403 guidance for soil makes the following reference to use patterns, "the Agency recommends that further evaluation and appropriate exposure-reduction activities be undertaken when soil-lead concentrations exceed 400 ppm
." In addition, there may be some areas of a residence where lead levels may be irrelevant to the task of preventing lead exposure (e.g., basement crawl spaces, attics).

Since the objective of the Section 403 rule is to characterize the residential lead-based paint hazard which, by definition, involves human exposure at levels that would result in adverse health effects, this characterization may involve recognition of the behaviors of the two most vulnerable populations.

3.0 TIERED STANDARDS

It is often assumed that a standard necessarily represents a single value for the targeted environmental medium. Such a rule structure, however, is only one of many potential formats. The rule can specify a series of levels, each associated with a particular response and/or recommendation taken from the available range. There are at least three issues that complicate any effort to assign a single value.

1. It is inherently difficult to determine one level at which adverse health effects begin. Since lead may be harmful in any concentration, the challenge is to identify standards which are both attainable and consistent with preventing adverse health impacts. The specific associated health effects (e.g., IQ deficits, blood pressure elevations, mental retardation) vary depending on the elevation of the exposure. The classification of blood-lead concentrations identified by the CDC provides some guidance, but a determination of what levels of exposure are unacceptable is still debatable.

2. There is statistical uncertainty (potentially quite considerable) in predicting blood-lead concentrations based only on information about environmental lead levels. For example, if epidemiological data is utilized to characterize the relationship between environmental lead and blood-lead concentrations, the variables portraying that relationship are estimated with some degree of uncertainty.

3. There are different levels of protection and concern that EPA may want the rule to express from the standpoint of setting priorities. For example, EPA may provide standards that both recognize when environmental levels and conditions represent a moderate level of concern and attention (thereby warranting interim controls), and identify when the levels and conditions represent a more clear and severe hazard (thereby warranting more intensive intervention action).

These three factors can be addressed with varying degrees of success. When considered together, however, they suggest a potential advantage to utilizing tiers of values within the standard.

In the interim Section 403 Guidance [1], EPA utilized such a rule structure with their tiered standard for soil. Recommended response activities were provided depending upon the measured bare soil-lead concentration and the use pattern of the area in question. For example, concentrations in excess of 5000 ppm prompt a recommendation of soil abatement. In contrast, lower levels, 400 ppm for areas used by children, 2000 ppm for all other areas, warrant the recommendation of interim control procedures.

4.0 INTEGRATED STANDARD — COMBINING SOIL, DUST, AND PAINT

Finally, it might be appropriate to consider a set of integrated standards. There are two primary reasons for considering an integrated standard. First, lead exposures from different media are additive. A combination of lead levels in paint, dust, and soil might together represent a health threat greater than any stemming from the media individually. Second, it may be necessary to consider data from one medium when setting a standard (or recommending actions) for another medium. An integrated standard recognizes the interconnected nature of the three environmental media, and provides recommendations or responses consistent with their combined exposure. There are myriad combinations of these factors and other factors in hazard definition, such as condition of paint and friction and impact surfaces. For example, one may not define intact paint on a friction surface a hazard if low dust-lead and soil-lead levels are found. However, it may be defined as a hazard if there are high dust-lead levels. The danger of any such standard lies in its complexity. If too complex, the integration becomes a black box construction that is inaccessible to many stakeholders and end-users. It is also potentially complicated to develop such an integrated standard.

FORMAT AND STRUCTURE OF THE SECTION 403 RULE

DISCUSSION ISSUES

The Environmental Protection Agency is seeking comment and insight into a range of relevant issues on this topic.

The definition of a lead-based paint hazard will be based on a target population of children 6 years of age or younger and pregnant women. When considering exposure to lead in dust, areas in the residence that are frequented by children and where lead hazards exist are the primary areas of exposure. Areas frequented by adults but where children rarely go, and areas rarely visited by either parent or child, represent less of an exposure threat. Rooms such as utility rooms, attics, unfinished basements, and storage rooms can be classified into one of these categories. However, rooms frequented only by parents also pose a potential lead hazard as parents can track dust from that room into common areas. Likewise, when considering exposure to lead in soil, areas such as play areas are more likely to result in exposure than other areas, such as areas restricted by shrubs, fencing, or other barriers.

How should areas in the residence, such as unfinished basements, attics, and storage rooms, that are not normal living spaces be handled?

How should areas in the a residence's yard, such as areas covered by thorny bushes or restricted by fencing, be handled?

Are use restrictions an appropriate control method where a hazard is found?

See Section 3.0 of the paper, "Format and Structure of the Section 403 Rule: Background Information", for discussion.

If tiered standards are implemented, will the lowest (or highest) level drive all "real world" actions? How will this differ for different segments of the regulated community?

a. property owners,
b. insurance markets,
c. financing markets,
d. local or state enforcement agencies,
e. others.

There are two primary reasons for considering an integrated standard. First, lead exposure from different media is additive. A combination of lead levels in paint, dust, and soil might together represent a health threat greater than any stemming from the media individually. Second, it may be necessary to consider data from one medium when setting a standard (or recommending actions) for another medium. See Section 4.0 of the paper, "Format and Structure of the Section 403 Rule: Background Information", for further discussion.

Following are two completely hypothetical examples of how an integrated standard may be implemented, presented for illustration purposes only. The first example presents an integrated standard in a very simple form where the standard for dust is dependent on soil. The second example presents a more complex integrated standard involving dust, soil, and the presence of lead-based paint (LBP) on targeted surfaces (friction, impact, chewable surfaces).

HYPOTHETICAL EXAMPLE 1:	The standard for dust is set at 200 µg/ft if soil levels are less than 1000 ppm. The standard for dust is set at 100 µg/ft if soil levels are greater than or equal to 1000 ppm.

HYPOTHETICAL EXAMPLE 2: A home passes an integrated standard for paint, dust, and soil if one of these conditions is met:

A. There is no deteriorated LBP

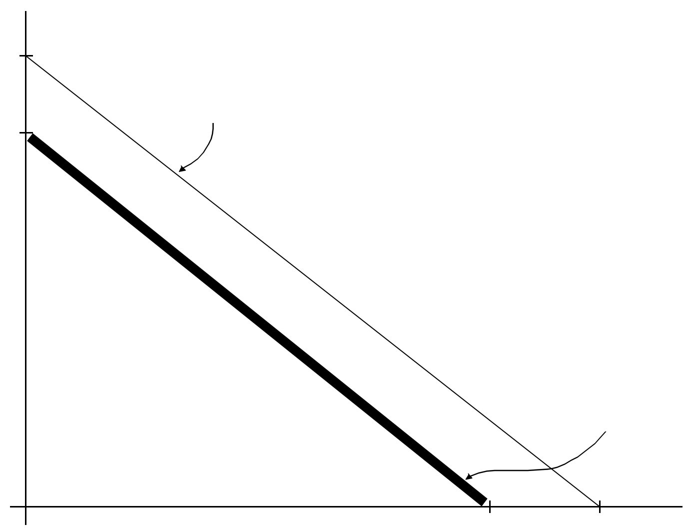
<u>and</u> there is no LBP on target surfaces

<u>and</u> the point representing soil and dust levels falls below the thin line on the graph below.

B. There is no deteriorated LBP

<u>and</u> there is LBP on target surfaces

<u>and</u> the point representing soil and dust levels falls below the thick line on the graph below.



The interim Section 403 guidance [1] for soil provides examples of interim controls designed to change use patterns (such as planting thorny shrubs to limit access, moving play equipment, or installing fencing) when soil levels exceed 400 ppm. When soil levels exceed 5000 ppm in residential bare soil, the guidance recommends soil abatement. A range of similar response actions may also be appropriate for different levels of dust-lead loading and concentration, with low levels resulting in recommendation of routine cleaning, and high levels resulting in specialized cleaning or response actions directed at other media. What is the appropriate extent of recommending response actions in this rulemaking?

REFERENCES

[1] U.S. Environmental Protection Agency, "Guidance on Identification of Lead-Based Paint Hazards;" Notice. Federal Register, pp 47248-47257, September 11, 1995.

[2] U.S. Department of Housing and Urban Development, "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing." Office of Lead-Based Paint Abatement and Poisoning Prevention, Washington DC, HUD-1539-LBP, July 1995.